# Aviation Safety Program

The Aviation Safety Program, part of NASA's Aeronautics Research Mission Directorate, explores ways to improve the overall safety of aircraft that fly today in U.S. airspace and those that will fly in the U.S. system for tomorrow—the Next Generation Air Transportation System, or NextGen.

One of the biggest challenges to developing the NextGen by the year 2025 is improving safety while also improving efficiency in more crowded skies. New aircraft will use new operations; people will have new roles.

To safely integrate those new requirements, the Aviation Safety Program conducts research to:

- Identify safety concerns that could emerge from a more decentralized future airspace system;
- Explore whether data mining of digital flight data and voluntarily submitted reports can reveal vehicle issues as well as flight operations issues;
- Study and identify causes of engine icing;
- Improve on-board systems that monitor overall vehicle "health" to make maintenance more efficient;
- Analyze system-wide safety properties of vehicles and operations and the safety aspects of software-intensive systems;
- Develop advanced flight control systems for new aircraft;
- Analyze how communication networks accommodate both human-automation and human-human interactions; and
- Test the safety and durability of new materials proposed for future vehicles.
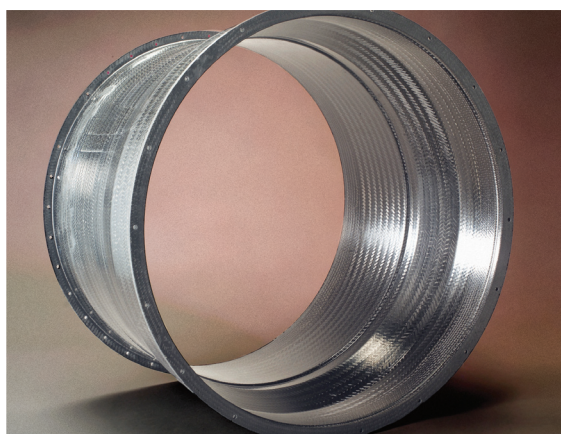
Images (Clockwise, left to right) **Composite Materials:** This lightweight turbofan jet engine casing is durable enough to protect against potential internal fan-blade failure. **AirStar Flight Tests:** NASA's remotely piloted flight-test program uses subscale aircraft models to test technologies that could help pilots recover from loss of control. **Engine Icing Research:** The NASA aircraft S-3B Viking routinely flies into storm clouds suspected to cause ice accumulation that can clog and damage jet engines. **Flight Systems Research:** NASA uses its F-18 research aircraft to test new flight deck or flight control technologies for the Next Generation Air Transportation System

NASA**facts**

RESEARCH AREAS

Integrated Vehicle Health Management Project

The primary goal of this project is to find ways to monitor, detect, predict, and even correct, problems automatically.

Major research challenges include:
- Developing on-board systems that can predict, detect, diagnose and propose solutions for failures that involve the airframe, propulsion systems, avionics (hardware) and software;
- Creating reliable and accurate systems that reveal vehicle or airspace problems before they become accidents; and
- Designing and testing new sensors that detect and display airframe and engine icing and other environmental hazards.

Integrated Intelligent Flight Deck Technologies Project

This project enables transformations toward safer operations for future flight deck systems. Researchers are pursuing a "NextSafe" approach that integrates new technologies, computer-based tools and operating procedures into a solution that improves overall safety.

Major research challenges include:
- Assigning clear roles and responsibilities to human and automated agents;
- Predicting human and automated agent performance in both normal and abnormal conditions;
- Evaluating human, automation, and joint human-automation performance to help make automation more comprehensible to pilots;
- Predicting joint human-automation performance in operating environments that are not yet realized, such as the NextGen's trajectory-based operations;
- Achieving a "better than visual" flight operations capability; and
- Enabling a highly collaborative working environment for flight deck system operators.

Integrated Resilient Aircraft Control Project

This project and its Integrated Dynamics and Flight Controls sub-project develop techniques to help pilots recover safely from a sudden loss of control, damage to control surfaces, or upsets caused by changes in weather or other aircraft.

Major research challenges include:
- Understanding the dynamics of current and future aircraft when in damaged and upset conditions;
- Developing control systems that adapt reliably to both the anticipated and the unanticipated;
- Developing aircraft guidance for emergency operation;
- Modeling and sensing airframe and engine icing; and
- Modeling effective and reliable human-automation systems.

Aircraft Aging and Durability Project

Researchers for this project develop ways to detect and manage aircraft aging-related hazards before they become critical. They seek full knowledge about current aircraft to help create technologies and processes that improve aircraft longevity in future aircraft designs.

Major research challenges include:
- Improving understanding of how cracks in materials start and grow;
- Developing computer models to predict crack growth in metallic and nonmetallic materials;
- Identifying the durability of nonmetallic (composite) materials used for aircraft fuselages;
- Improving the ability to detect bonded joint degradation;
- Identifying the long-term service and environmental needs of composite jet engine containment cases;
- Improving understanding of how quickly engine disks operating at hotter temperatures degrade over time; and
- Developing new software tools to better identify and repair wiring faults.

We're Working on...

Developing a computer-based model that predicts the degradation caused by environmental effects on selected polymer-matrix composite materials

Simulating advanced flight deck technologies and operations in a NextGen-based environment to see whether safety is improved in performance, situational awareness and crew workload

Identifying or developing advanced approaches to enable improved and cost-effective safety assurance for future flight-critical systems

For more information about the Aviation Safety Program and NASA aeronautics research, visit **www.aeronautics.nasa. gov/programs_avsafe.htm**.

NASA Facts